U.S. Department of Transportation
Federal Highway Administration

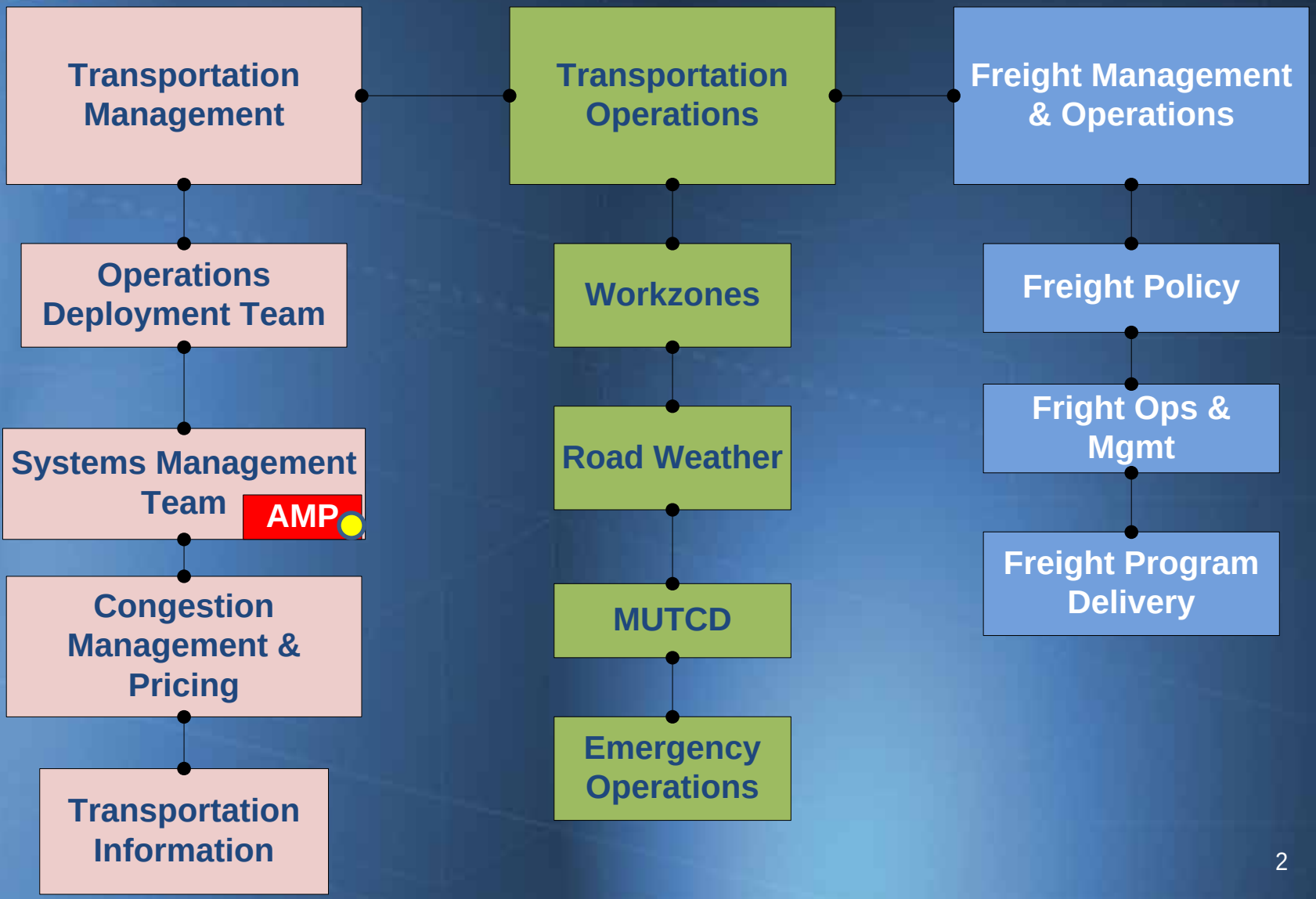
Active Traffic Signal Management Workshop

December 13, 2011
Merrillville, Indiana

FHWA TECHNICAL INITIATIVES

Eddie Curtis, P.E.
FHWA Office of Operations / Resource Center

FHWA Office of Operations



Arterial Management Program

Program Vision:

Arterial facilities are consistently operated to achieve maximum efficiency and safety for all users.

Strategies & Tools:

- Research
- Guidance & Training
- Outreach

Active Traffic Signal Management

In Class Quiz

On your own please write in 25 words or less:

Your definition of “Traffic Signal Operations”

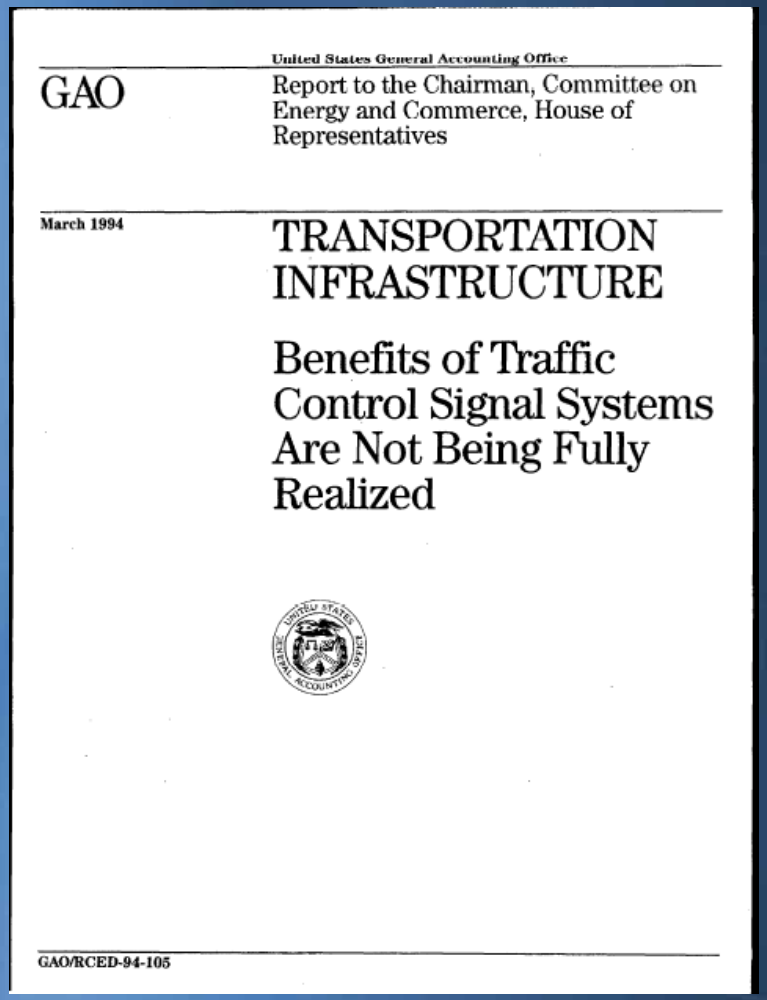
- No discussing this with your neighbor!
- This will be anonymous!
- Hand it in,

Research

- Evaluation of Advanced Traffic Signal Management Systems (ASCT)
- Managing the Performance of Traffic Signals
- Regional Traffic Signal Operations Programs
- Signal Timing Under Saturated Conditions

- Adaptive Control Software
  - ACSLite
  - RHODES
  - OPAC
  - RTACL

Background



United States General Accounting Office

GAO

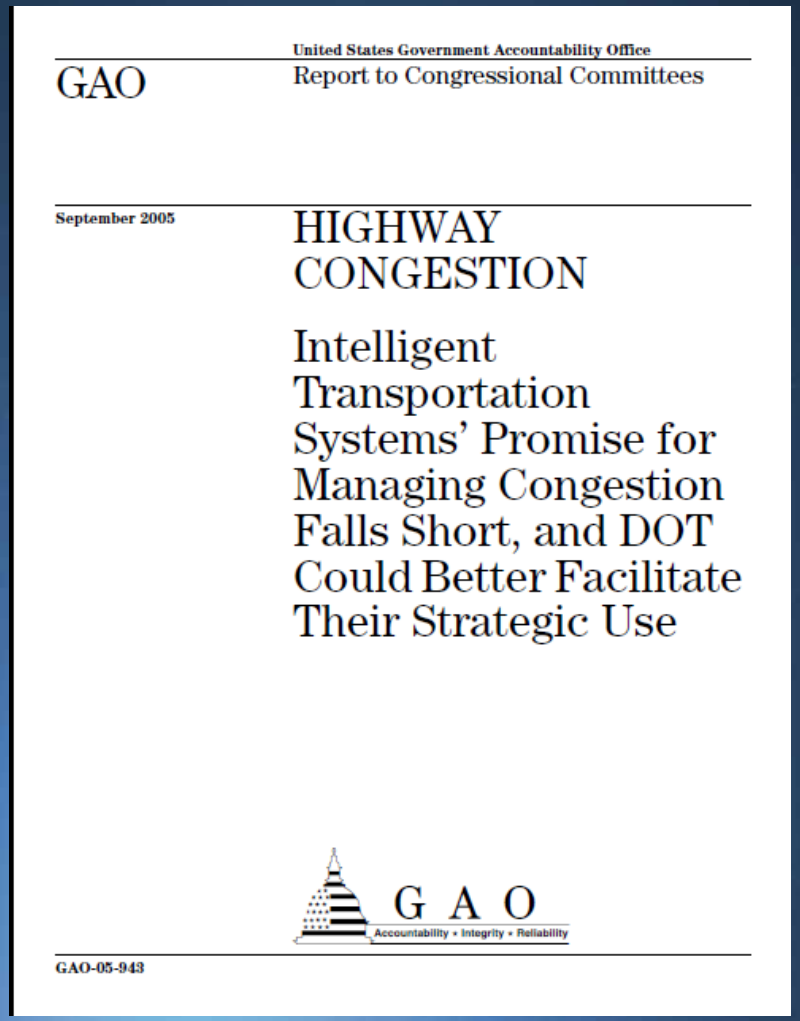
Report to the Chairman, Committee on Energy and Commerce, House of Representatives

March 1994

TRANSPORTATION INFRASTRUCTURE

Benefits of Traffic Control Signal Systems Are Not Being Fully Realized

GAO/RCED-94-105



United States Government Accountability Office

GAO

Report to Congressional Committees

September 2005

HIGHWAY CONGESTION

Intelligent Transportation Systems' Promise for Managing Congestion Falls Short, and DOT Could Better Facilitate Their Strategic Use

G A O

Accountability • Integrity • Reliability

GAO-05-943

Guidance

- Model Systems Engineering Documentation for ASCT
- Improving Traffic Signal Management: A Basic Service Concept
- Regional Traffic Signal Operations Programs
- Signal Timing Under Saturated Conditions
- Traffic Signal Timing Manual
- Signal Timing on a Shoestring

Training

- Managing Traffic Signal Systems (TSS) Basic Service Model
- Evaluating the Performance of TSS
- Applying Systems Engineering To TSS
- Traffic Signal Timing Concepts
- Mobile Hands on Signal Timing Training
- Traffic Signal Design & Operations
- Computerized Traffic Signal Systems

Outreach

- Every Day Counts
- Traffic Signal Report
- NTOC Traffic Signal Library & User Forum
- Professional Organizations
  - ITE
  - IMSA
  - APWA
- LTAP

Traffic Signal Report Card 2011

- http://www.ite.org/selfassessment/
- New and Improved
- Built around specific operational objectives

Deadline
December 15th

Better, Faster, Smarter

Shortening Project Delivery

- Planning & Environmental Linkages
- Legal Sufficiency Enhancements
- Expanding Use of Programmatic Agreements
- Use of In–Lieu Fee and Mitigation Banking
- Clarifying the Scope of Preliminary Design
- Flexibilities in ROW
- Flexibilities in Utility Accommodation and Relocation
- Enhanced Technical Assistance on Ongoing EISs

Technology Innovation

- Warm Mix Asphalt
- Precast Bridge Elements
- Geosynthetic Reinforced Soil
- Safety Edge
- **Adaptive Signal Control Technology ~~(ACSLITE)~~**

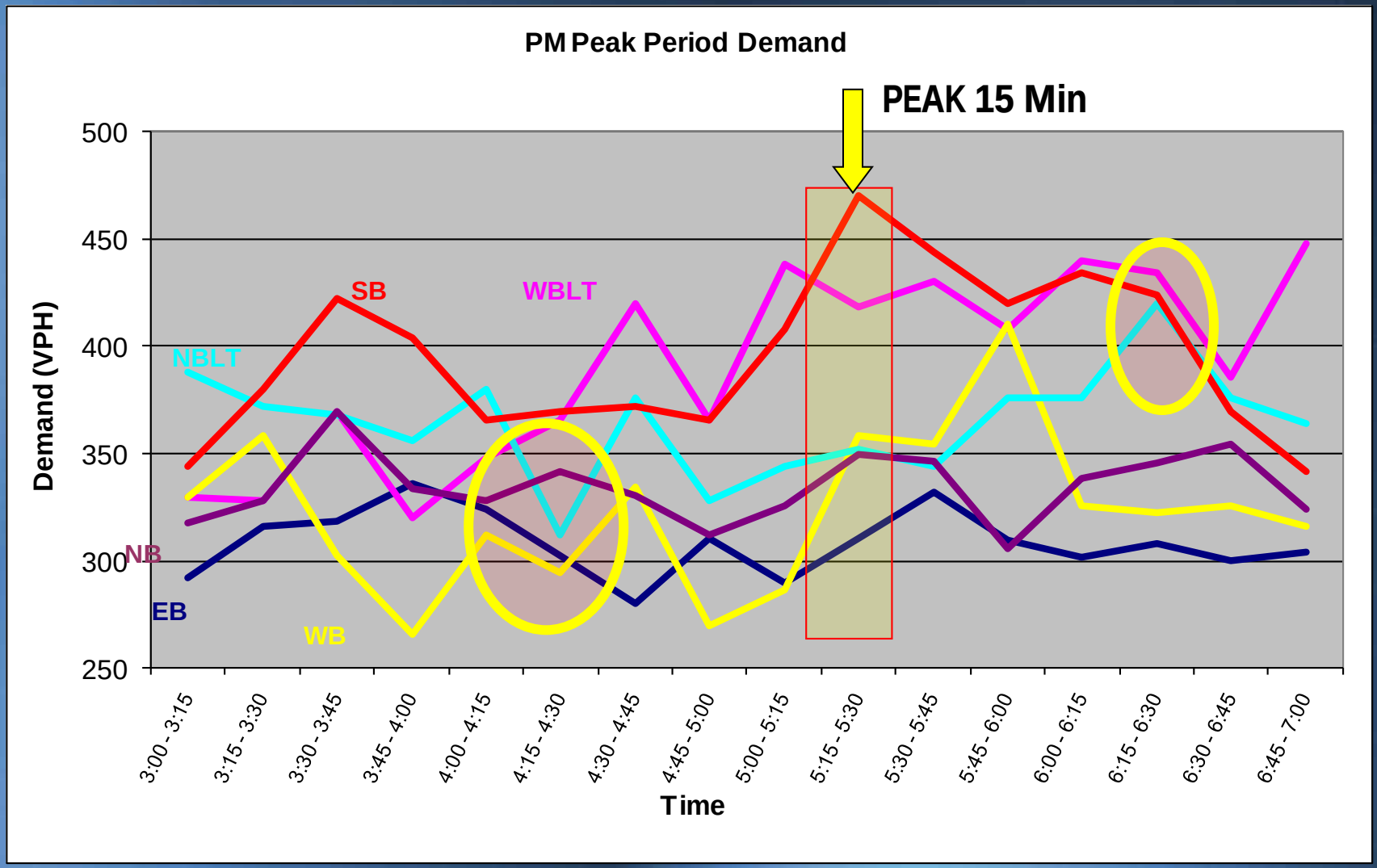
What Do Motorists Want?

- *"Why do I have to wait when there's nobody else moving"*
  - Translation: Equitable distribution of green time
- *"Can't I just drive down the street?"*
  - Translation: Progression—driving through successive greens

Traffic Signal Performance

- Trigger Event
- Data Collection
- Modeling / Optimization
- Implement & Fine Tune
- Reporting

Variability is Normal—And the Problem



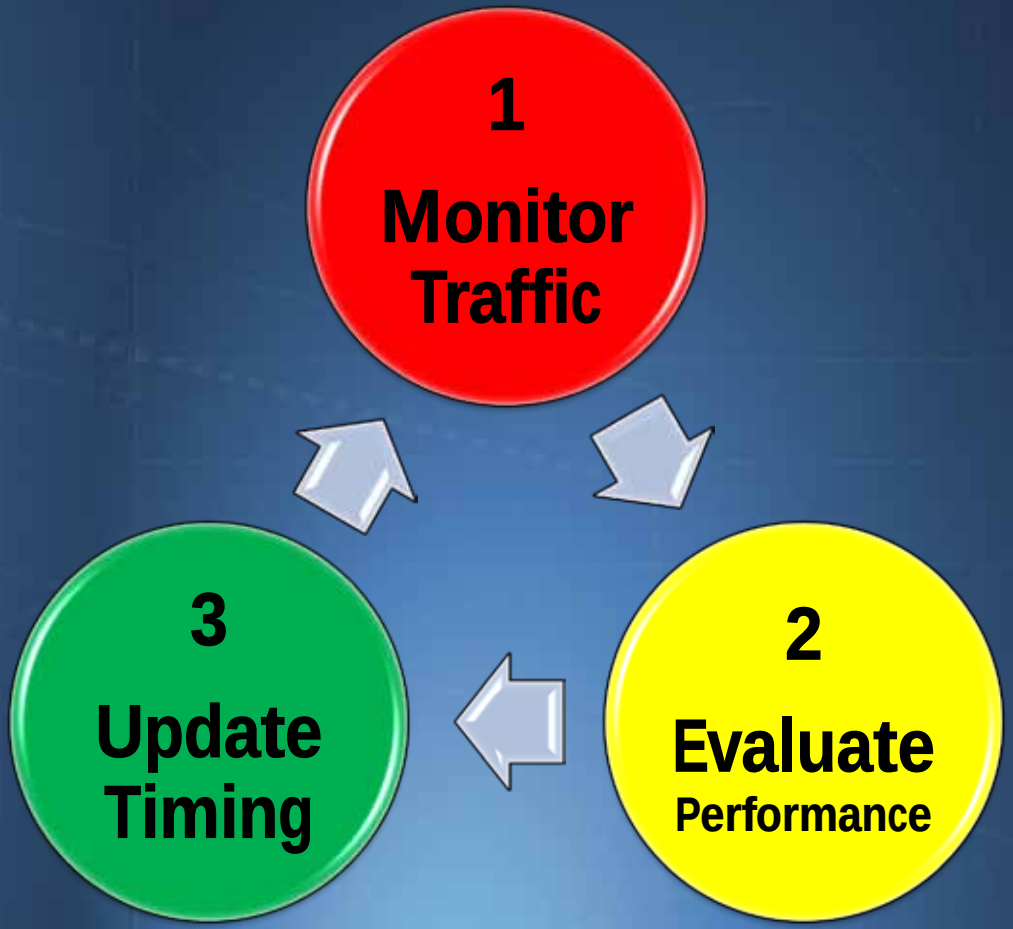
The Big Box Scenario – Year 1

Year 10

Year 13

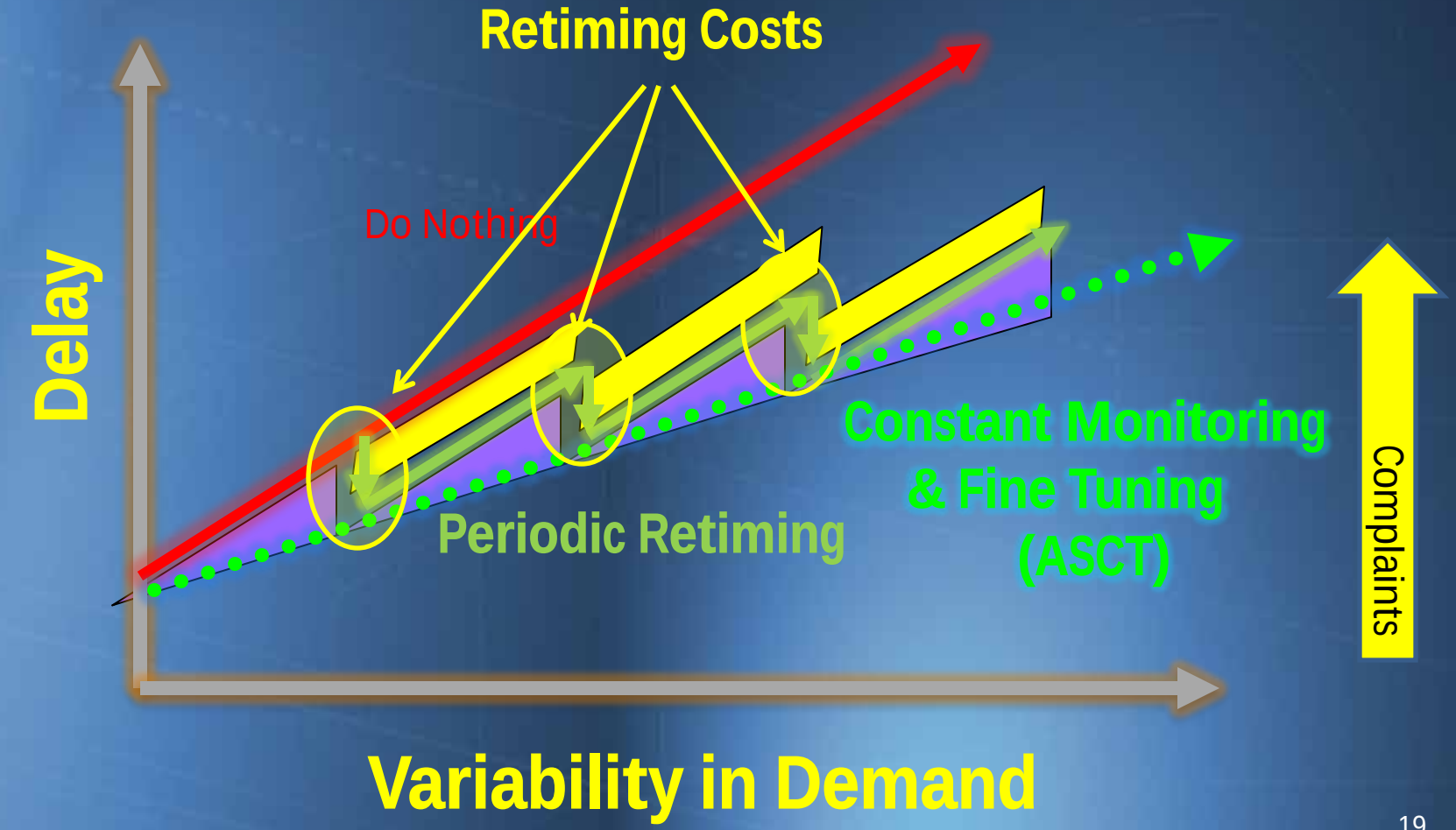
Adaptive Signal Control Technology

- Trigger Event
- Data Collection
- Modeling / Optimization
- Implement & Fine Tune
- Reporting



Benefits

$d = d1(PF) + d2 + d3$

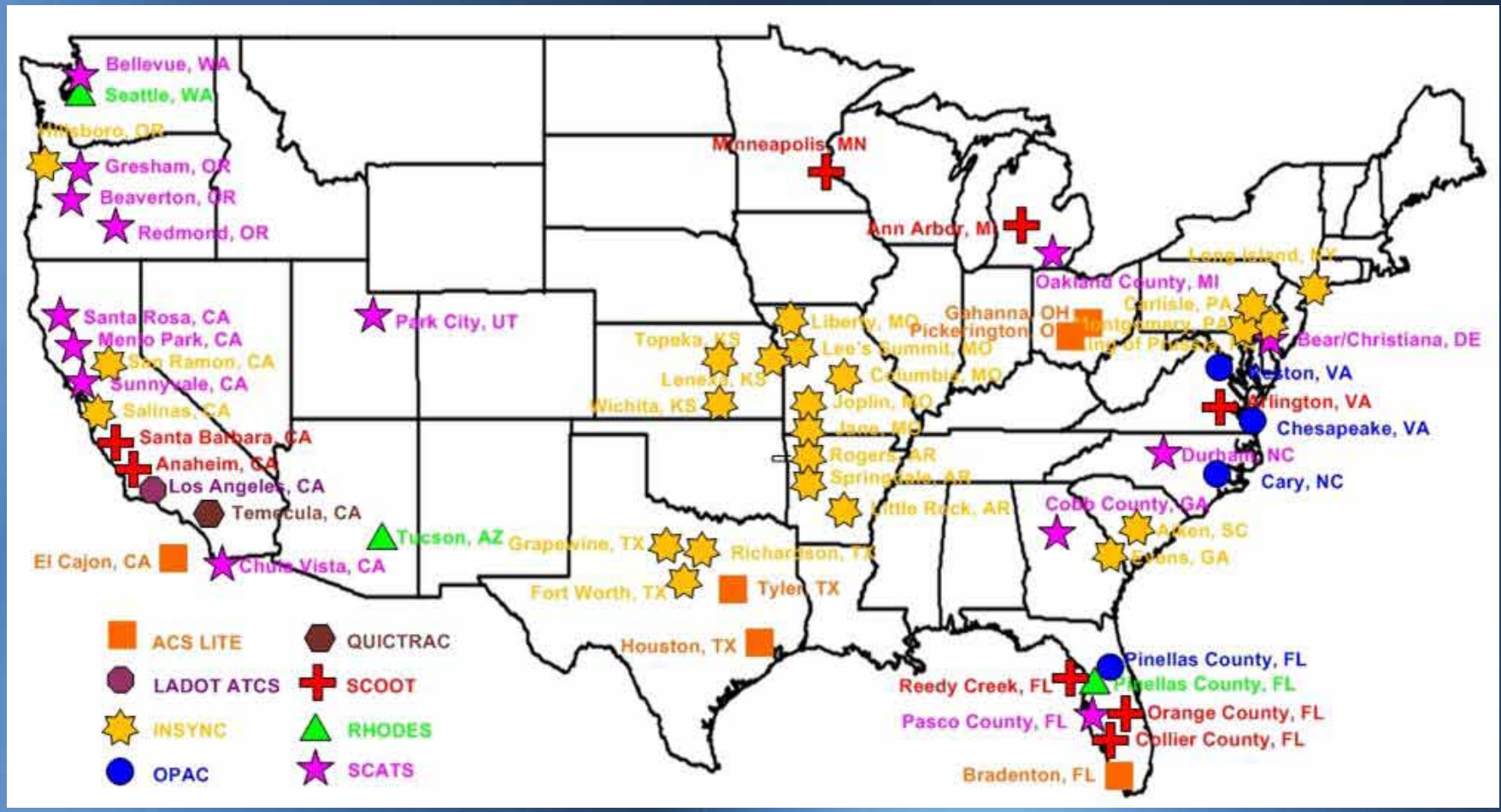


Source: City of Alpharetta

Adaptive Signal Control Technology

- Better
  - Benefits to Road Users & Agencies
  - Ongoing performance measurement
- Smarter
  - Solves problems that are difficult to address with time-of-day and traffic responsive
  - Saves cost of mundane data collection and retiming
- Faster
  - Reduces retiming intervals from years to minutes

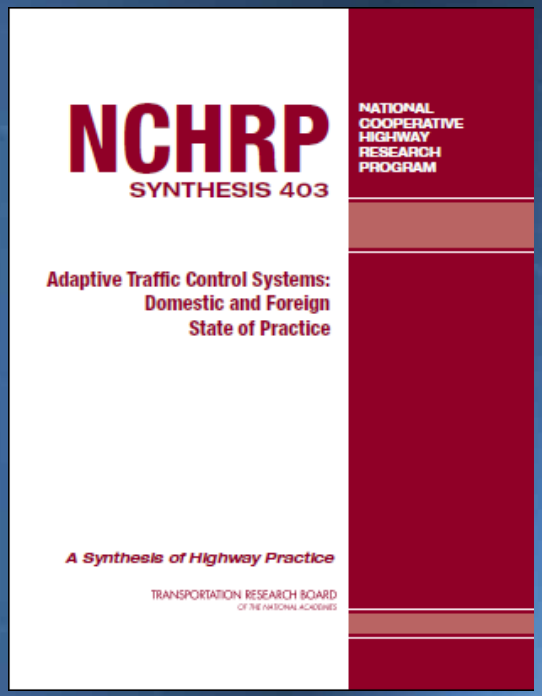
ASCT Deployment Status



Source: Aleksandar Stevanovic, Florida Atlantic *University*

Readily Available ASCT

- ACSLite
- BALANCE
- InSync
- LA ATCS
- MOTION
- OPAC
- RHODES
- SCATS
- SCOOT
- UTOPIA



- QuicTrac
- NWS Voyage
- Multi-criteria Adaptive Control
- KLD
- Intelight
- Synchro Green
- System of the Month

Barriers to Adoption

- Stakeholder Meeting

- Complexity
  - Model Systems Engineering Document for ASCT
- Cost
  - Planning for Operations
    - Align Arterial Operational Objectives with Planning Goals
- Uncertainty about Benefits
  - Supplement Traditional MOEs
    - Arrivals on Green
    - Green time Utilization

The Vision

Adaptive Signal Control Technology (ASCT) used as an operations strategy where traffic demand and agency capabilities support implementation.

- Goal : The EDC / ASCT tools are used to guide the implementation or programming of 40 **ASCT** systems.

- EDC / ASCT tools
  - Systems Engineering Process
    - SE Model Documents
    - SE Workshop

EDC Resources

Outreach

- Systems Engineering Workshops
- Showcases

Guidance

- Model Systems Engineering Documents
- MOEs and Evaluation Procedures (May 2012)

Training

- Systems Engineering for ASCT (July 2012)
- Evaluating the Performance of ASCT (July 2012)
- Traffic Signal Timing Concepts (July 2012)
- Developing Traffic Signal Management & Operations Plans: Basic Service Concept (July 2012)

Possible Approaches

- Consumer Reports
  - Evaluate Available Technology
  - Consult with vendors / Distributors
  - Deploy small scale system
  - Evaluate
  - Abandon or Expand
- Systems Engineering
  - Objectives
  - Needs / Constraints
  - Requirements
  - Design
  - Implement
  - Verification
  - Validation
  - Abandon or Expand

What are the Risks - ASCT?

- Problem could be solved with other strategies
- Functional Objectives of the system do not align with agency objectives
- Loss of other critical functions / features
- Constraints not properly addressed
- Cost
- Maintenance

Other Risk Issues

- Technology NEW to most
- Technology still evolving
- Most systems have very limited track record
- Documented history of failed ASCT projects (40%)
- Significantly increased complexity
- Extremely dependant upon other stuff
  - Communications systems
  - Detection
  - Staff
- Not “one size fits all”
- Often pitched as silver bullet

The Role of Systems Engineering

Understanding the problem

Managing risk

- **Projects getting bogged down with shifting requirements**
- **Acquisitions being challenged by unsuccessful bidders/proposers/vendors**
- **Projects not meeting agency needs**

+ it is mandatory for federal-aid projects

Basic Systems Engineering Deliverables

- Concept of Operations
- Requirements
- High Level Design
- Verification Plan
- Validation Plan

Model Systems Engineering Document for ASCT Systems

- Purpose of the Document
- How to use the Document
- Document Organization


U.S.Department of Transportation
Federal Highway Administration

Model Systems Engineering Documents for Adaptive Signal Control Technology (ASCT) Systems

Draft Guidance Document

August 2011

FHWA-HOP-11-027

Purpose of SE Model Documents

- Evaluate need for Adaptive Control
- Usual process too much work for small projects…
- …but small projects still impose big risk to small agencies
- Model documents greatly reduce effort by providing wording and documentation…
- …but agencies still must identify their needs

Model Document *Process*

Answer a series of questions

- Questions that will be important during design
- Guidance for answers to questions include concept of use
- Answer link to scenarios and requirements

Evaluate constraints

- Would relieving a constraint allow better answers?

Ask questions again with different constraints

What are my next steps?

I manage a large city, with over 1000 traffic signals, I'm considering adaptive signal control for some intersections, but how do I determine the right place for adaptive?

Due to new air quality standards that are out, I need to improve my network. Is it time to consider adaptive control?

I'm a technologist and want to use the latest and greatest. I just heard about adaptive control and it sounds great, I want one! What do I do next to get it?

I been working with my consultant/vendor for many years and they have been telling me about new adaptive traffic control systems that I should consider. What locations would be the best fit for an adaptive control system?

I have very old traffic control system and with my recent grant I think I can afford a new system. Is it time to consider adaptive control?

I am getting calls on a couple of my intersections and I cannot solve the cycle/phase issues. Will adaptive control help?

I have tried time of day coordination and even traffic responsive plan selection, but I feel like there could be something better. Could adaptive control be a better solution?

I have a corridor that I run time of day coordination, but occasionally diverting traffic overwhelms the corridor, could adaptive control provide a better solution?

The planners are telling me that in the next 5-10 years there will be a 50% growth along the main corridor in the city, the current traffic control system will not handle the traffic based on the current capacity. Is it time to consider an adaptive control?

(1)

Concept of Operation

What are my current situation, needs, goals, and objectives? (Traffic & inventory)

Check list

(2)

Concept of Operation

In absence of adaptive control, what more could I do to optimize my current system? What limitations would remain?

Identified and defined traffic issues

Check list

(3)

Concept of Operation

Select closest situation and problem statement. OR Create custom problem statement

Deficiencies in existing System (Part A)

Check list, instructions

Map

Situation and problem statement

(4)

Concept of Operation

What scenarios will fit my current and future traffic situation? Will I need to generate custom scenarios?

Check list, instructions
Pre-defined Scenarios
User defined Scenarios

A

(5)

Concept of Operation

Envisioned (to-be) concept for adaptive control

Check list, instructions

Envisioned scenarios
Include
Fault scenarios

(6)

Requirements

What will I need to prepare for adaptive control?

Check list, instructions
Pre-defined Requirements
User defined Requirements

Top level requirements for operations (user requirements)

(7)

Requirements

Which type of adaptive control is best for me?

Check list, instructions
Pre-defined Requirements
User defined Requirements

System requirements

(8)

Design

Evaluating existing adaptive control systems

Check list, instructions
Compare Requirements and product characteristics

B

B

(9)

Verification Plan

How can I make sure the system will work per the stated requirements?

Verification tests

(10)

Validation Plan

How can I determine that the system fulfills my needs?

Validation tests

Implement System

Questions

- Section 4.8.1 Network Characteristics
  - What is the size of the network that needs to operate adaptively, both now and in the future?

Con Ops Ref #	Concept of Operations Sample Statements	Guidance Section	Sys Req
8.1.0-1	The agency has plans to adaptively control a total of XX intersections?	4.8.1	1.0-1
8.1.0-2	The system will control intersections in groups that are defined by the operator.	4.8.1	1.0-2 1.0-2.0-2
8.1.0-3	A group of intersections may be comprised of simply one intersection, or up to the total number of intersections sufficiently close to warrant coordination under prevailing traffic conditions	4.8.1	1.0-2.03

Agency Examples

- NJ MASSTR
- Chattanooga, TN
- GA SR9
  - Alpharetta, Sandy Springs, Roswell, GDOT

Dec 15th T3 Webinar 1:00-2:30pm

What's Coming

- Performance Management
  - Measures of Effectiveness
  - Prioritizing Activities
  - Guides investment
- Planning for Operations
  - Regional Traffic Signal Operations Program

Traffic Signal Report Card 2011

- http://www.ite.org/selfassessment/
- New and Improved
- Built around specific operational objectives

Complete it by December 15th.

Questions?

http://www.fhwa.dot.gov/everydaycounts

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